

REMARKS/ARGUMENTS

Favorable reconsideration of this application, in light of the following discussion, is respectfully requested.

Claims 1 and 3-5 are pending in the present application.

In the outstanding Office Action, Claims 1 and 3-5 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

Addressing the above-noted rejection, that rejection is traversed as discussed next.

The outstanding Action indicates that the subject matter, "... without incorporating a deasphalting treatment and without mixing a hydrogen donor stream ..." recited in Claim 1, was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the subject matter.

Applicants first note that as provided in Ex parte Parks, 30 USPQ2d 1234, an adequate description under 35 U.S.C. § 112, first paragraph, does not require *literal* support for the claimed subject matter, and that it is sufficient if the originally-filed disclosure would have conveyed to one skilled in the art such claimed subject matter is present or inherent in what is presented in the specification.¹

With that in mind, Applicants provide the following evidence in support of the adequate description of the above-noted subject matter recited in Claim 1.

The specification at page 11, lines 4-11 provides support for the thermal cracking, and describes as follows:

The heavy oil content 15 (vacuum residue (15))
separated at such step of separating a crude oil by
distillation where the distilling section 10 is used and

¹ See attached Ex parte Parks, 30 USPQ2d 1234.

obtained substantially from the bottom of the distilling section 10 is introduced to the thermal cracking section 20, in which the heavy oil content 15 is thermally cracked and separated into a lightened thermal cracking product 21 and a thermal cracking residue 25 (the step of thermal cracking).

As described above, the thermal cracking cracks a vacuum residue into a lightened thermal cracking product (e.g. cracked gas and cracked oil) and thermal cracking residues (e.g. pitch and coke). It should be emphasized that one skilled in the art would have understood from the above-noted portion of the specification that the claimed thermal cracking is a process that will produce and separate thermal cracking residues, such as pitch and coke, from cracked vapor mainly by a thermal condensation and polymerization reaction in a thermal cracking reactor. The cracked vapor is treated and recovered later as cracked gas and cracked oil. Attached with the present response are references that describe three thermal cracking technologies for a residue feed, and these references are believed to assist in confirming that the claimed thermal cracking is performed without a deasphalting treatment and without a hydrogen donor stream.²

Turning to a discussion of a deasphalting treatment, the deasphalting treatment is a treatment that separates large asphaltene molecules from oil by utilizing a solvent. The large asphaltene molecule is a precursor to be converted to thermal cracking residues such as pitch and coke. Further, such a deasphalting treatment is used in known thermal cracking processes that do not separate thermal cracking residues by themselves. That is, the deasphalting treatment is used to eliminate a pitch or coke precursor, which can cause a

² "Heavy Oil Processing Handbook": Published in April 1991 by RAROP in Japan, which stands for Research Association for Residual Oil Processing as a special project organization, and which is sponsored by Japanese MITI (Ministry of International Trade and Industry).

variety of problems (e.g. plugging and fouling), from a raw material and product oil to minimize a formation of pitch or coke in the thermal cracking process.

On the contrary, as the claimed thermal cracking may separate by itself and produce thermal cracking residues, the claimed thermal cracking does not use a deasphalting treatment to eliminate a pitch or coke precursor from a raw material and product oil to suppress the formation of pitch or coke.

Turning to a discussion of a hydrogen donor stream, the hydrogen donor stream can also be used to suppress the formation of pitch or coke. For example, in a thermal cracking process, large molecules are converted to smaller-sized molecules, many bonds among carbon atoms are broken, and many radical carbons are formed. The radical carbons can easily recombine with other molecules to grow to a larger molecule, and finally form pitch or coke. If a hydrogen donor stream is added during this process, the radicals can be quenched and stabilized with hydrogen to some degree. As a result, formation of pitch or coke can be suppressed. However, as noted above, as the claimed thermal cracking does not need to suppress the formation of pitch or coke, the claimed thermal cracking does not use a hydrogen donor stream.

Just as the description of the process in the attached Parks decision³ “would seem to cry out for a catalyst if one were used,” the discussion of the process here would cry out for a discussion of deasphalting or use of a hydrogen donor stream if either of these were being used.

In summary, as evidenced by the foregoing remarks, the deasphalting treatment and hydrogen donor stream are not used in the claimed thermal cracking.

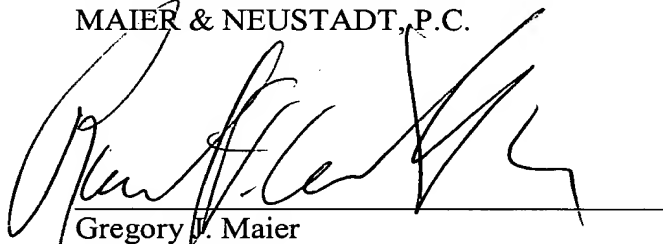
³ See Parks at 30 USPQ2d 1236.

Accordingly, it is respectfully submitted that the above-noted claimed subject matter finds an adequate description under 35 U.S.C. § 112, first paragraph, and respectfully requested the rejection be withdrawn.

As no other issues are pending in this application, it is respectfully submitted that the present application is now in condition for allowance, and it is hereby respectfully requested that this case be passed to issue.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'Gregory J. Maier', is written over a horizontal line.

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FULL TEXT OF CASES (USPQ2D)

All Other Cases

Ex parte Parks (BdPatApp&Int) 30 USPQ2d 1234 (9/2/1993)

Ex parte Parks (BdPatApp&Int) 30 USPQ2d 1234

Ex parte Parks

U.S. Patent and Trademark Office, Board of Patent Appeals and Interferences

30 USPQ2d 1234

Decided September 2, 1993

No. 93-2740

Headnotes

PATENTS

1. Practice and procedure in Patent and Trademark Office -- Reissue -- Broader claims sought
(§ 110.1313)

Patentability/Validity -- Specification -- Written description (§ 115.1103)

Claims in reissue application for method of determining nitrogen content of sample were improperly rejected on ground of inadequate descriptive support under 35 USC 112, first paragraph, since originally-filed disclosure need only convey, to one of skill in art, that applicant had possession of concept of what is claimed in order to satisfy description requirement, since lack of literal basis in disclosure for limitation that decomposition step of claims be "conducted in the absence of a catalyst" thus does not establish prima facie case for lack of descriptive support, and since it cannot be held that originally-filed disclosure would not have conveyed concept of effecting decomposition at elevated temperature in absence of catalyst.

2. Practice and procedure in Patent and Trademark Office -- Reissue -- Broader claims sought
(§ 110.1313)

Claims in reissue application for method of determining nitrogen content of sample are overbroad under

35 USC 251, since application was filed more than two years after grant of original patent, since any claim which does not contain negative limitation expressly excluding presence of catalyst in decomposition step of method is broader than original claims, and since claims in question do not accomplish such exclusion by reciting phrase "consisting essentially of" in characterizing decomposition step.

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Particular patents -- Chemical -- Nitrogen detection

4,018,562, Parks and Marietta, chemiluminescent nitrogen detection apparatus and method, claims 81-93 in application for reissue rejected.

Case History and Disposition:

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Appeal from final rejection of claims in application for reissue of patent (Jill Johnston, primary examiner).

Application of Robert E. Parks and Robert L. Marietta, serial no. 708,810, filed May 31, 1991, continuation of serial no. 340,540, filed April 18, 1989 and abandoned, for reissue of patent no. 4,018,562, granted April 19, 1977 on application serial no. 625,510, filed Oct. 24, 1975 (chemiluminescent nitrogen detection apparatus and method). From final rejection of all claims in application, applicants appeal. Rejection of claims 1-10, 20-22, 55-80, and 94-106 reversed; rejection of claims 81-93 affirmed.

Judge:

Before Calvert, vice chairman, and Steiner and Tarring, examiners-in-chief.

Opinion Text

Opinion By:

Steiner, examiner-in-chief.

This is an appeal from the final rejection of claims 1 through 10, 20 through 22 and 55 through 106, all the claims in this application for reissue of Patent No. 4,018,562 (the '562 patent).

THE INVENTION

The claimed invention is a method for determining the nitrogen content of a sample comprising manipulative steps which include decomposing the sample in an oxygen/inert gas atmosphere at an elevated temperature to obtain nitric oxide and causing the generated nitric acid to undergo a chemiluminescent reaction with ozone.

Claims 1, 81 and 94 are illustrative and read as follows:

1. The method for determining the total chemically combined nitrogen content of a sample comprising the steps:

a. decomposing said sample in one step in the presence of an oxygen-rich atmosphere of oxygen and an inert gas and at a temperature sufficiently above 700 degrees C. that substantially all of the chemically bound nitrogen is recovered as nitric oxide (NO), such decomposition being conducted in the absence of a catalyst,

b. causing the nitric oxide produced by such decomposition to undergo a chemiluminescent reaction with ozone, and

c. determining the magnitude of the chemiluminescent reaction to indicate the quantity of chemically combined nitrogen in said sample.

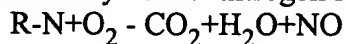
81. A method for determining the total chemically combined nitrogen content of a sample, said method comprising the steps of: (a) decomposing said sample in one step, said decomposing step consisting essentially of decomposing said sample in the presence of an oxygen-rich atmosphere of oxygen and an inert gas and at a temperature sufficiently above 700 degrees C that substantially all of the chemically bound nitrogen is recovered as nitric acid (NO);

(b) causing the nitric oxide produced by such decomposition to undergo a chemiluminescent reaction with ozone; and

(c) determining the magnitude of the chemiluminescent reaction to indicate the quantity of chemically combined nitrogen in said sample.

94. A method for determining the total chemically combined nitrogen content of a sample, said method comprising the steps of:

(a) decomposing said sample in one step in the presence of an oxygen-rich atmosphere of oxygen and an inert gas and at a temperature sufficiently above 700 degrees C that substantially all of the chemically bound nitrogen is recovered as nitric oxide (NO) according to the formula:



(b) causing the nitric oxide produced by such decomposition to undergo a chemiluminescent reaction with ozone; and

(c) determining the magnitude of the chemiluminescent reaction to indicate the quantity of chemically combined nitrogen in said sample.

THE REJECTIONS

Claims 1 through 10, 20 through 22 and 55 through 80 stand rejected under the first paragraph of 35 U.S.C. 112 for lack of adequate descriptive support. Claims 81 through 106 stand rejected under 35 U.S.C. 251 in that they are broader than the originally patented claims. 1 In addition, all the

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appealed claims stand rejected under 35 U.S.C. 251 for lack of the requisite "error."

The rejection under the first paragraph of 35 U.S.C. 112, the rejection of claims 94 through 106 under 35 U.S.C. 251 as broader than the original claims, and the rejection of all the appealed claims under 35 U.S.C. 251 for lack of the requisite "error" are reversed; the rejection of claims 81 through 93 under 35 U.S.C. 251 as broader than the original claims is affirmed.

OPINION

The Rejection of Claims 1 through 10, 20 through 22 and 55 through 80 under the first paragraph of 35 U.S.C. 112. The initial burden of establishing a *prima facie* basis to deny patentability to a claimed invention on any ground is always upon the examiner. *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In rejecting a claim under the first paragraph of 35 U.S.C. 112 for lack of adequate descriptive support, it is incumbent upon the examiner to establish that the originally-filed disclosure would not have reasonably conveyed to one having ordinary skill in the art that an appellant had possession of the now claimed subject matter. *Wang Laboratories, Inc. v. Toshiba Corp.*, 993 F.2d 858, 26 USPQ2d 1767 (Fed. Cir. 1993). Adequate description under the first paragraph of 35 U.S.C. 112 does not require *literal* support for the claimed invention. *In re Herschler*, 591 F.2d 693, 200 USPQ 711 (CCPA 1979); *In re Edwards*, 568 F.2d 1349, 196 USPQ 465 (CCPA 1978); *In re Wertheim*,

541 F.2d 257, 191 USPQ 90 (CCPA 1976). Rather, it is sufficient if the originally-filed disclosure would have conveyed to one having ordinary skill in the art that an appellant had possession of the concept of what is claimed. *In re Anderson*, 471 F.2d 1237, 176 USPQ 331 (CCPA 1973).

[1] The examiner contends that the rejected claims lack adequate descriptive support because there is "no literal basis for the" 2 claim limitation "in the absence of a catalyst." Clearly, the observation of a lack of literal support does not, in and of itself, establish a *prima facie* case for lack of adequate descriptive support under the first paragraph of 35 U.S.C. 112. *In re Herschler*, *supra*; *In re Edwards*, *supra*; *In re Wert heim*, *supra*.

The examiner notes that in *Parks v. Fine*, 773 F.2d 1577, 227 USPQ 432 (Fed. Cir. 1985), involving the claimed subject matter, the limitation "in the absence of a catalyst" was considered material. Suffice it to say, no issue under the first paragraph of 35 U.S.C. 112 for lack of adequate descriptive support for the limitation "in the absence of a catalyst" was before the court.

We are not unmindful of the decision in *Ex parte Grasselli*, 231 USPQ 393 (Bd.App. 1983) *aff'd* *mem.*, 738 F.2d 453 (Fed. Cir. 1984), which involved claims to a process for the ammoxidation of propane or isobutane employing a catalyst "free of uranium and the combination of vanadium and phosphorus." Under the particular facts in that case, it was held that the negative limitation introduced new concepts in violation of the description requirement of the first paragraph of 35 U.S.C. 112, citing *In re Anderson*, *supra*. In the situation before us, 3 it cannot be said that the originally-filed disclosure would not have conveyed to one having ordinary skill in the art that appellants had possession of the concept of conducting the decomposition step generating nitric acid in the absence of a catalyst. See, for example, column 5 of the '562 patent, first paragraph, wherein FIG. 4 is discussed. Pyrolysis temperatures of between 600 degrees C and 700 degrees C, and above 700 degrees C were employed to achieve conversion of chemically bound nitrogen to nitric oxide. Smooth conversion was obtained above 700 degrees C, while the optimum conversion was found to occur above 900 degrees C. Throughout the discussion which would seem to cry out for a catalyst if one were used, no mention is made of a catalyst.⁴

Moreover, according to two declarations by Wentworth, a professor of chemistry at the University of Houston, whose expertise in this particular art has not been challenged, one having ordinary skill in the art would have recognized that the reaction generating nitric oxide, according to the equation disclosed in the '562 patent, is conducted without a catalyst. See *Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 19 USPQ2d 1111

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(Fed. Cir. 1991); *In re Lemin*, 364 F.2d 864, 150 USPQ 546 (CCPA 1966). Thus, it cannot be said that the originally-filed disclosure would not have conveyed to one having ordinary skill in the art the concept of effecting decomposition at an elevated temperature in the absence of a catalyst. *In re Anderson*, *supra*.

Accordingly, the examiner's rejection of claims 1 through 10, 20 through 22 and 55 through 80 under the first paragraph of 35 U.S.C. 112 for lack of adequate descriptive support is reversed.

The Rejection of Claims 81 through 106 under 35 U.S.C. 251 as Broader than the Original Claims.

We initially observe that on page 6 of the Brief,

appellants agree that any claim in the reissue application that does not contain a limitation that means "in the absence of a catalyst" is broader than original claims 1-10 and hence unpatentable under 35 USC 251 (appellants' emphasis).

Claims 81 through 106 do not contain a negative limitation which expressly precludes the presence of a catalyst. However, appellants contend that claims 81 through 93 exclude the presence of a catalyst by virtue of the phrase "consisting essentially of" in characterizing the decomposition step, and that claims 94 through 106 exclude the presence of a catalyst by virtue of the recited equation for the decomposition reaction, which equation does not reflect the presence of a catalyst.

[2] In our opinion, the phrase "consisting essentially of," as employed in claims 81 through 93, limits

decomposition to a single step and, in that sense, is redundant since decomposition is performed "in one step." However, it is not apparent and appellants have not explained why the expression "consisting essentially of" excludes the presence of a catalyst during the recited decomposition step. 5 It would, therefore, appear that claims 81 through 93 are broader than original claims 1 through 10 and, hence, were properly rejected by the examiner under 35 U.S.C. 251. Accordingly, the examiner's rejection of claims 81 through 93 under 35 U.S.C. 251 is affirmed.

Claims 94 through 106 recite the decomposition reaction in a manner which, according to the Wentworth declarations, means that no catalyst was employed. *In re Lemin, supra*. Accordingly, claims 94 through 106 would not appear broader than original claims 1 through 10 and, hence, the examiner's rejection of claims 94 through 106 under 35 U.S.C. 251 is reversed.

The Rejection of the Appealed Claims Under 35 U.S.C. 251 for Lack of the Requisite Error.

This rejection is reversed essentially for the reasons advocated by appellants on appeal. We emphasize that the practice of submitting claims as a hedge against the possible invalidity of original claims has been judicially sanctioned. See, for example, *Hewlett-Packard Co. v. Bausch & Lomb, Inc.*, 882 F.2d 1556, 11 USPQ2d 1750 (Fed. Cir. 1989); *In re Altenpohl*, 500 F.2d 1151, 183 USPQ 38 (CCPA 1974); *In re Handel*, 312 F.2d 943, 136 USPQ 460 (CCPA 1963).

In summary, the examiner's rejection of claims 81 through 93 is affirmed; the rejection of claims 1 through 10, 20 through 22, 55 through 80 and 94 through 106 is reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR 1.136(a). See the final rule notice, 54 F.R. 29548 (July 13, 1989), 1105 O.G. 5 (August 1, 1989).

AFFIRMED-IN-PART.

Footnotes

Footnote 1. The ultimate paragraph of 35 U.S.C. 251 reads as follows:

No reissued patent shall be granted enlarging the scope of the claims of the original patent unless applied for within two years from the grant of the original patent.

Footnote 2. See page 4 of the Answer, second full paragraph, line 4, and page 7 thereof, last two lines.

Footnote 3. Whether the requirement for an adequate written description has been met is a question of fact and, hence, driven by the exigencies of each case. *Wang Laboratories, Inc. v. Toshiba Corp.*, 993 F.2d 858, 26 USPQ2d 1767 (Fed. Cir. 1993).

Footnote 4. A "catalyst" normally functions to accelerate a particular reaction. See for example, Hawley, *Condensed Chemical Dictionary*, Tenth Edition, 1981, pp. 205 and 206, copies of which are enclosed for appellants' convenience and made of record.

Footnote 5. Compare *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 229 USPQ 805, 812, note 6 (Fed. Cir. 1986).

- End of Case -

DELAYED COKING PROCESS

1. FEATURES & APPLICATIONS

Delayed Coking Process produces coke, gas oil, naphtha, through the thermal cracking of heavy residue such as vacuum residue and thermal cracked tar. The coking process has the advantages of being capable of cracking heavy oils that are not easily processed otherwise, and yielding cracked gas oil which is suited as a feedstock for catalytic cracking process.

The feature of delayed coking process is that through the enough residence time in reaction zone or coke drum, the thermal cracking and successive coking of heavy residue proceeds more sufficiently compared with other thermal cracking processes. The by-product coke can be used, after calcining, as material for electrode of aluminum smelting or electric furnace steelmaking if the impurity level of the coke is sufficiently low. Higher impurity cokes may be sold to the cement industry or the power generating stations and simply burned as fuel.

Typical impurities of delayed coke are sulfur and metals such as nickel and vanadium.

Premium cokes having low sulfur, low metals, low porosity, low coefficient of thermal expansion (CTE), and good conductivity, often called as "needle coke", are manufactured from low sulfur highly aromatic stocks, such as thermal cracked tars and decant oils from catalytic crackers. Electrode made

from needle-coke exhibits superior performance in electric furnace steelmaking under severe operating conditions.

2. PROCESS FLOW

The process flow of delayed coking is illustrated in Figure 1.

The main facilities consists of two or more coke drums, a feed furnace and a fractionator, and is equipped with high-pressure water jets for decoking and a coke pit.

The charge is fed directly to the fractionator where it is flushed and combined with the recycle oil at the bottom. The combined feed is pumped to the coker furnace where it is exposed to cracking temperature for a short time, sufficiently short that almost no cracking takes place, and then it is sent to a coke drum. In the coke drum, the vapor-liquid mixture cracks itself with its own heat to yield coke. The coke drums are switched over at a preset time interval, to remove the deposited coke.

The overhead vapor from the coke drums enters the fractionator at the point below the baffle and is separated into gas, naphtha, gas oil and recycle oil. The recycle oil flows to the bottom of the fractionator where it combines with fresh feed.

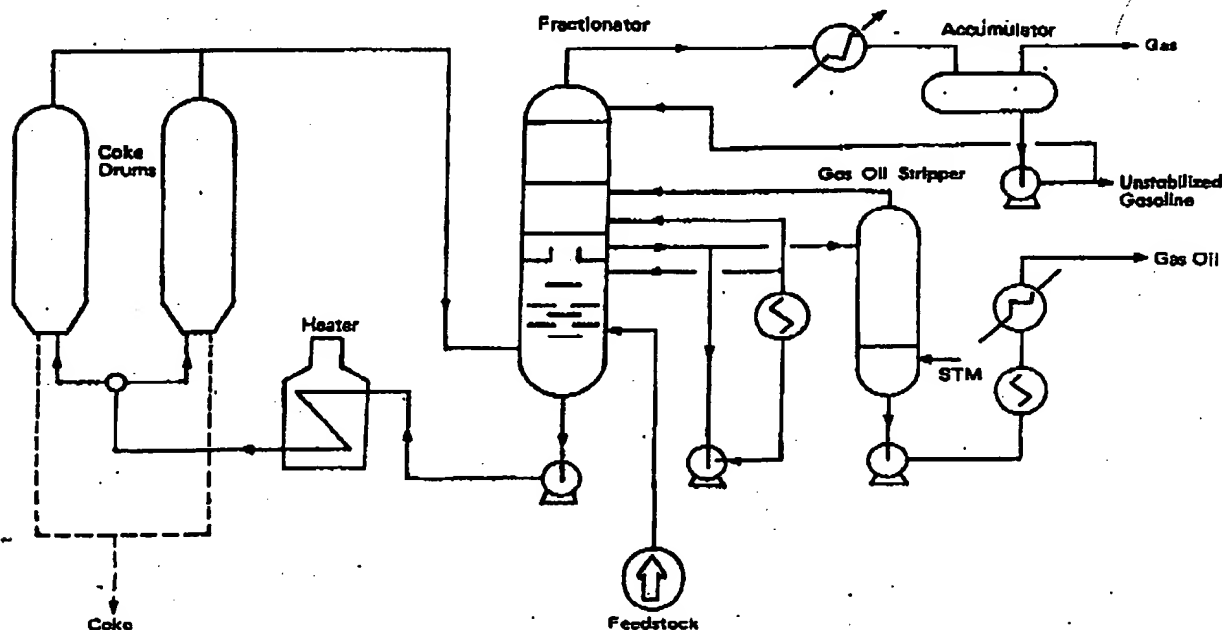


Figure 1 Delayed Coking Process Flow Diagram

Table 1 Operational Data of Delayed Coking Process

		Thermal Tar	California Residue	Midcontinent Type Residue
Feedstock				
Sp. Gr., 15/4°C		1.09	0.986	0.984
Sulfur	wt%	0.58	1.6	0.38
CCR	wt%	8.6	9.6	11.3
Product Yields	wt%			
Gas		18.1	12.0	6.3
Naphtha		0.9	15.7	16.0
Gas Oil		21.1	50.7	56.5
Coke		59.9	21.6	21.0
	Total	100.0	100.0	100.0
Operating Conditions				
Heater outlet temp.	°C	507	498	487
Drum pressure	kg/cm ² G	3.5	4.2	2.1
Recycle ratio		1.08	0.3	0.1

3. OPERATIONAL DATA

The yields and qualities of products are the functions of the properties of feedstock and operating conditions of the unit.

The feedstock properties which affect coke yield and quality are such as Conradson carbon, API gravity, Watson characterization factor, boiling range, contaminants etc.

As for the operating conditions, cracking temperature and pressure of the coke drum and recycle ratio are the main factors.

In general, if the pressure and/or recycle ratio, are increased gas and coke make increases while liquid hydrocarbon yield will decrease.

Table 1 shows the yields and operating data of a thermal tar feed for producing needle coke and of typical residues from California and Midcontinent crudes for producing non-needle sponge coke.

Distillates from coker are unstable in quality because they are produced by cracking reactions. They are usually upgraded by reforming, catalytic cracking and hydrogenation.

4. ECONOMICS

Economic data of delayed coking process are typically illustrated in Table 2.

Table 2 Typical Economics of Delayed Coking Process

PLANT CAPACITY,	BPSD	10,000
INVESTMENT COST,		
(Basis: 1982, Japan)	10 ⁶ yen	8,000
UTILITIES CONSUMPTION		
Fuel	10 ⁶ kcal/h	20
Power	KW	600
Steam	t/h	13
Cooling Water	t/h	2,000

5. COMMERCIAL INSTALLATIONS

The total capacity of installed delayed coking units amounts to approximately 1,200,000 BPD in USA and 600,000 BPD in the rest of the world.

6. DEVELOPMENT BY

Foster Wheeler Energy Corp., UOP Inc., C-E Lummus, The M.W. Kellogg Inc., Koa Oil Co., Continental Oil Co.

7. REFERENCES

- 1) Mekler, V. et al., Proceedings of API 39 [III] 229, (1959)
- 2) Kutler, A.A. et al., Oil & Gas Journal, 68, (14) 92, (1970)
- 3) Hydrocarbon Processing, 59, (9), 154, (1980)
- 4) Rose, K.E., Hydrocarbon Processing, 50, (7), 85, (1971)
- 5) Oil & Gas Journal, 77 (52), 148, (1979)
- 6) Debiase, R., Oil & Gas Journal, 80, (16), 81 (1982)
- 7) Oil & Gas Journal, 80, (12), 132 (1982)
- 8) Hydrocarbon Processing, 61, (6) SEC2, (1982)
- 9) Lou Ann Thrash, Oil & Gas Journal, 87 (52), 92 (1989)
- 10) Oil & Gas Journal, 88 (13), 77 (1990)

EUREKA PROCESS

1. FEATURES & APPLICATIONS

The Eureka process is a commercially proven thermal cracking process to produce valuable cracked oil and aromatic petroleum pitch from heavy residual materials.

In this process, reaction proceeds at lowered cracked oil partial pressure by injecting steam into the reactor, keeping petroleum pitch in a homogeneous liquid state. A higher cracked oil yield is obtained by this reaction than that of delayed cokers. The homogeneous pitch in a molten state ensures stable, continuous operation and allows to keep plant yard clean and hygienic.

The cracked oil after hydrotreating is used as FCC or hydrocracker feedstock, feedstock for olefin production and blending stock for low sulfur fuel oil.

The pitch is utilized as boiler fuel having an excellent quality, as partial oxidation feedstock for generating hydrogen and carbon monoxide, and an additive for manufacturing high-grade metallurgical coke from low grade coking coals.

2. PROCESS FLOW

Figure 1 shows a simplified flow diagram of the Eureka process. The feed, usually vacuum residue,

is fed to the preheater and then enters the bottom of the fractionator, where it is mixed with the recycle oil. The mixture is pumped up to the charge heater and fed through an automatically operated switching valve to the reactor system which consists of a pair of reactors operating alternately. Since the switching valve operates typically every two hours in this process, the cycle time is of the order of four hours. In the reactor, thermal cracking reaction takes place in the presence of superheated steam injected simultaneously. The function of this steam is to strip the cracked products out of the reactor and supply a part of heat required for cracking reaction.

At the end of the reaction, the bottom product is quenched and then allowed to blow down to a buffer drum. The pitch is sent to the pitch flaker by pump where liquid pitch is cooled and solidified to flakes.

The cracked products—oil and gas—from the top of the reactor and steam enter the lower section of the fractionator, where a small amount of entrainment is washed and removed. The upper section is an ordinary fractionator, where the heavier fraction of cracked oil is drawn as a side stream. The lighter fraction of cracked oil is obtained from the overhead drum as normal practice.

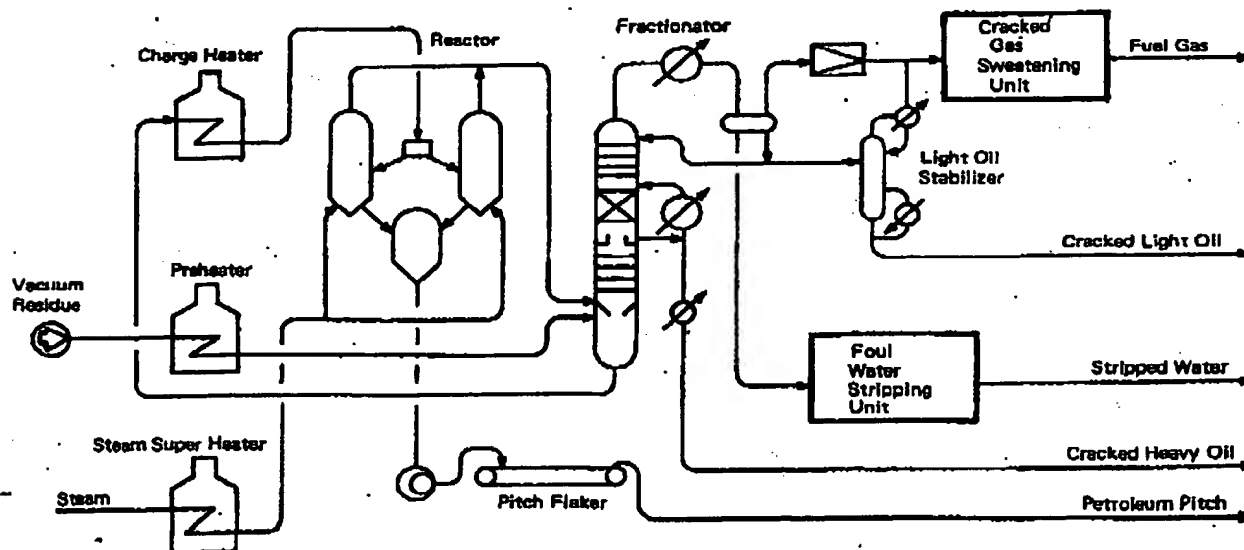


Figure 1 Eureka Process Flow Diagram

Table 1 Product Yields and Properties of Eureka Process

		FEED		PRODUCT		
			Cracked Gas	Cracked Light Oil	Cracked Heavy Oil	Pitch
Nominal Cut Point	°C	500+	C4 & Lighter	C5-240	240-540	—
Yield,	wt%	100	4.8	14.9	50.7	29.6
Sp. Gr., 15/4°C	—	1.017	—	0.767	0.926	1.207
Sulfur,	wt%	3.86	13.2	1.12	2.70	5.73
Nitrogen,	wt%	0.51	—	0.01	0.25	1.20
Nickel,	wt ppm	136	—	Nil	<0.3	487
Vanadium,	wt ppm	202	—	Nil	<0.2	688
CCR,	wt%	20.0	—	—	—	—
C7 Insolubles,	wt%	5.7	—	5ppm	62ppm	88.4
Br. No.	—	—	—	78.6	33.8	—
Diene Value,	—	—	—	4.8	4.4	—
Softening Point (1),	°C	—	—	—	—	225

Note: (1) Ring & ball method

(2) The combustion heat of sweet cracked gas product is approx. 0.47×10^6 kcal/kg of Feed.

Table 2 Economics of Eureka Process

PLANT CAPACITY,	BPSD	20,000
INVESTMENT COST,	10 ⁸ yen	8,400
UTILITIES CONSUMPTION		
Fuel,	10 ⁶ kcal/h	57
Power,	kW	2,600
Steam,	t/h	0
BFW,	t/h	63
Cooling Water ($\Delta T = 10^\circ\text{C}$),	t/h	900
Steam Condensate,	t/h	-9 (Export)

3. OPERATIONAL DATA

Typical data for processing vacuum residue from the mixture of Middle East crudes are shown in Table 1.

4. ECONOMICS

Typical economics data are shown in Table 2. (Japan, 1990).

5. COMMERCIAL INSTALLATIONS

The first commercial plant (20,000 BPSD) has been operating successfully at Fuji Oil refinery since 1976. The second commercial plant (20,000 BPSD) has been operated in the Peoples Republic of China.

6. LICENSED BY

Kureha Chemical Industry Co., Ltd. in cooperation with Chiyoda Corporation.

7. REFERENCES

- 1) Aiba, T., et al., AIChE National Meeting, Philadelphia, June, (1980)
- 2) Hirotani, Y., et al., ACS National Meeting, Atlanta, March, (1981)
- 3) Aiba, T., et al., NPRA Annual Meeting, San Antonio, March, (1982)

FLUID COKING PROCESS

1. FEATURES & APPLICATIONS

Fluid Coking is a continuous fluid bed thermal cracking process for upgrading residual petroleum stocks to gas oil, naphtha, gas, and coke. Fluid Coking is a versatile process which is applicable to a wide range of heavy feedstocks. The feedstock should have a Conradson Carbon Residue of more than 6%. There is no practical upper limit on CCR. Suitable feedstocks include vacuum residuum of all types, catalytic cracking polymer, asphalt, whole and reduced tar sands bitumen, visbreaker tar, and shale oil. Processing costs are insensitive to feed contaminants such as organic metals, ash, sulfur, and nitrogen. The heavier liquid products from the coker can provide large quantities of low sulfur fuel (less than 0.3wt% sulfur), after hydrotreating with commercially available process.

2. PROCESS FLOW

A simplified flow diagram of the Fluid Coking

process is illustrated in Figure 1. The Fluid Coking process uses two major fluid solids vessels; a reactor and a burner. After preheat in the scrubber, residuum feed is injected into the reactor where it is thermally cracked typically at 510 to 540°C to a full range of vapor products and a coke product which is deposited on fluidized coke particles. The sensible heat, heat of vaporization, and endothermic heat of cracking of the residuum are provided by a circulating stream of hot coke from the burner. Coke is withdrawn from the burner to keep the solids inventory constant.

To prevent the coke from becoming too coarse, large particles are selectively removed as product in the quench vessel, and coke fines are elutriated and returned to the burner. The product coke is quenched with water in the quench vessel, and pneumatically transported to storage. A simple jet attrition system in the reactor provides additional seed coke to maintain a constant particle size within the system.

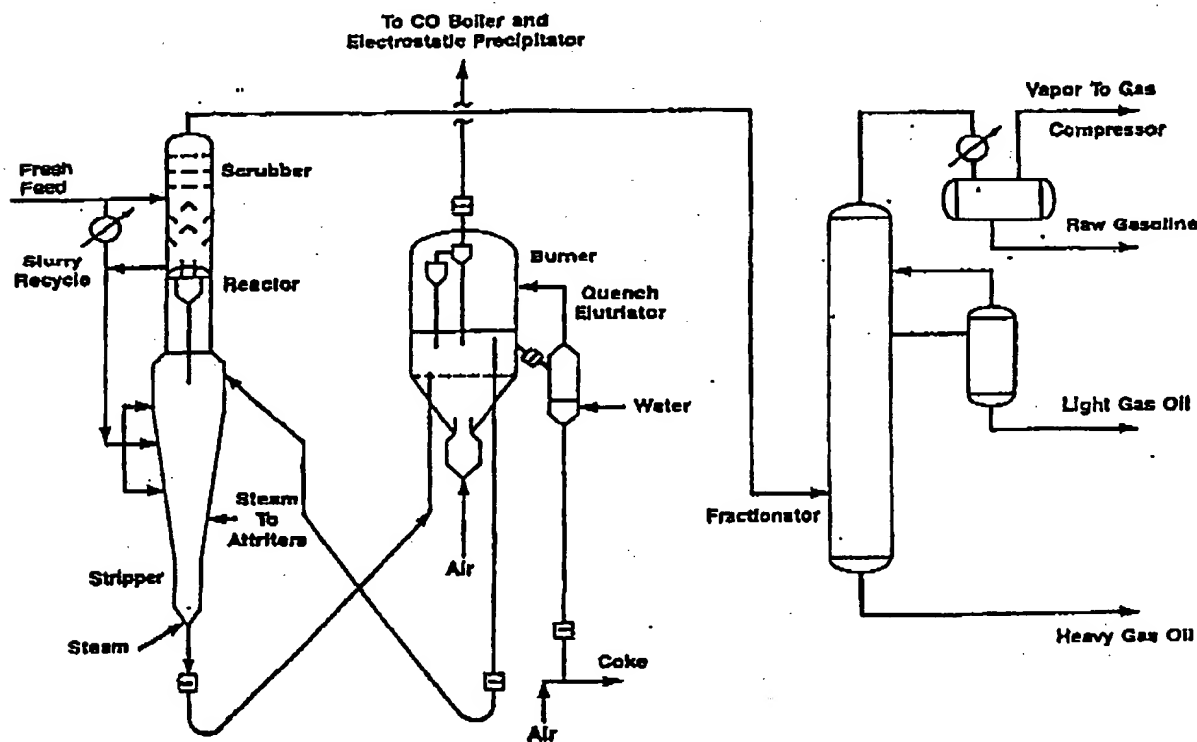


Figure 1 Fluid Coking Process Flow Diagram

3. OPETATIONAL DATA

Table 1 shows a product distribution based on Arabian Heavy 566°C⁺ resid. Lighter feeds would provide higher liquid yields and less coke. Similarly, lower sulfur feeds would provide lower sulfur products. The gas oil produced can be used as catalytic cracker or hydrocracker feedstock or can be

hydrodesulfurized for inclusion in various heating oil and fuel oil products. The naphtha is normally hydrotreated and reformed for motor gasoline. The light ends can be fractionated into cuts for alkylation, chemicals, or hydrogen unit feedstocks or used as fuel.

Table 1 Typical product Yields and Qualities

Feed	Product	Yield on Feed	% Feed Sulfur in Products	Product Properties
Vacuum Residue (566°C ⁺)	Reactor Gas (C ₁ -)	12 wt%	18	8% S/NII S ¹⁷
CCR wt% 27.8	Coker Naphtha (C ₆ -182°C)	12 wt%/17% vol%	2	0.8% S/41 ppm S ¹⁸
Sulfur wt% 6.0	Coker Gas Oil (182-524°C)	42 wt%/45 vol%	36	5.2% S/0.3% S ¹⁷
				65 ppm Vanadium
Vanadium+Nickel ppm 270	Coke burned for Heat Balance	6 wt%	3	7015 kcal/kg
Sp. Gr. 15/4°C 1.05	Net Coke (Product Coke)	28 wt%	41	9% sulfur

Notes: (1) Sulfur shown before/after desulfurization based on typical desulfurization in downstream processing facilities.

4. ECONOMICS

Economics data of the Fluid Coking process treating Arabian Heavy vacuum residuum (565°C⁺) are shown in Table 2.

Table 2 Economics of Fluid Coking Process

INVESTMENT COST,	US\$/BP&D	1000-1300"
Onsite facilities including product fractionator, co-boller and electrostatic precipitator, but excluding flue gas desulfurization.		
Direct materials and labor, 1989		
U.S. Gulf Coast		
UTILITIES CONSUMPTION, per kl feed:		
Power,	kw-hr	40
Steam, 600 psig. (produced)	ton	(0.56)
Steam, 125 psig	ton	0.04
Boiler feed water,	ton	0.94
Cooling water,	ton	4.8
Instrument and Utility Air,	Nm ³	1.7

5. COMMERCIAL INSTALLATIONS

Commercial installations are listed in Table 3.

Table 3 Fluid Coking Commercial Plants

Company	Location	Feed Rate, BP&D
Exxon	Billings, Montana	7,000
Tosco	Avon, California	42,000
Texasco	Bakersfield, Calif.	7,000
Star	Delaware City, Del.	45,000
Hess	Purvis, Mississippi	8,000
Permar	Madero, Mexico	10,000
Imperial	Sarnia, Canada	14,000
Exxon	Benicia, California	32,500
Syncrude	Mildred Lake, Canada	87,000 x 2

6. LICENSED BY

Exxon Research and Engineering Co.

7. REFERENCES

- 1) Encyclopedia of Chemical Processing and Design, Marcel Dekker, Inc., Publisher.
- 2) Brown, E.C., et al., Paper presented at NPRA annual meeting, March 30, (1976)
- 3) Allan, D.E., et al., Chemical Engineering Progress, 77 (12) 40, (1981)

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